P77-10113

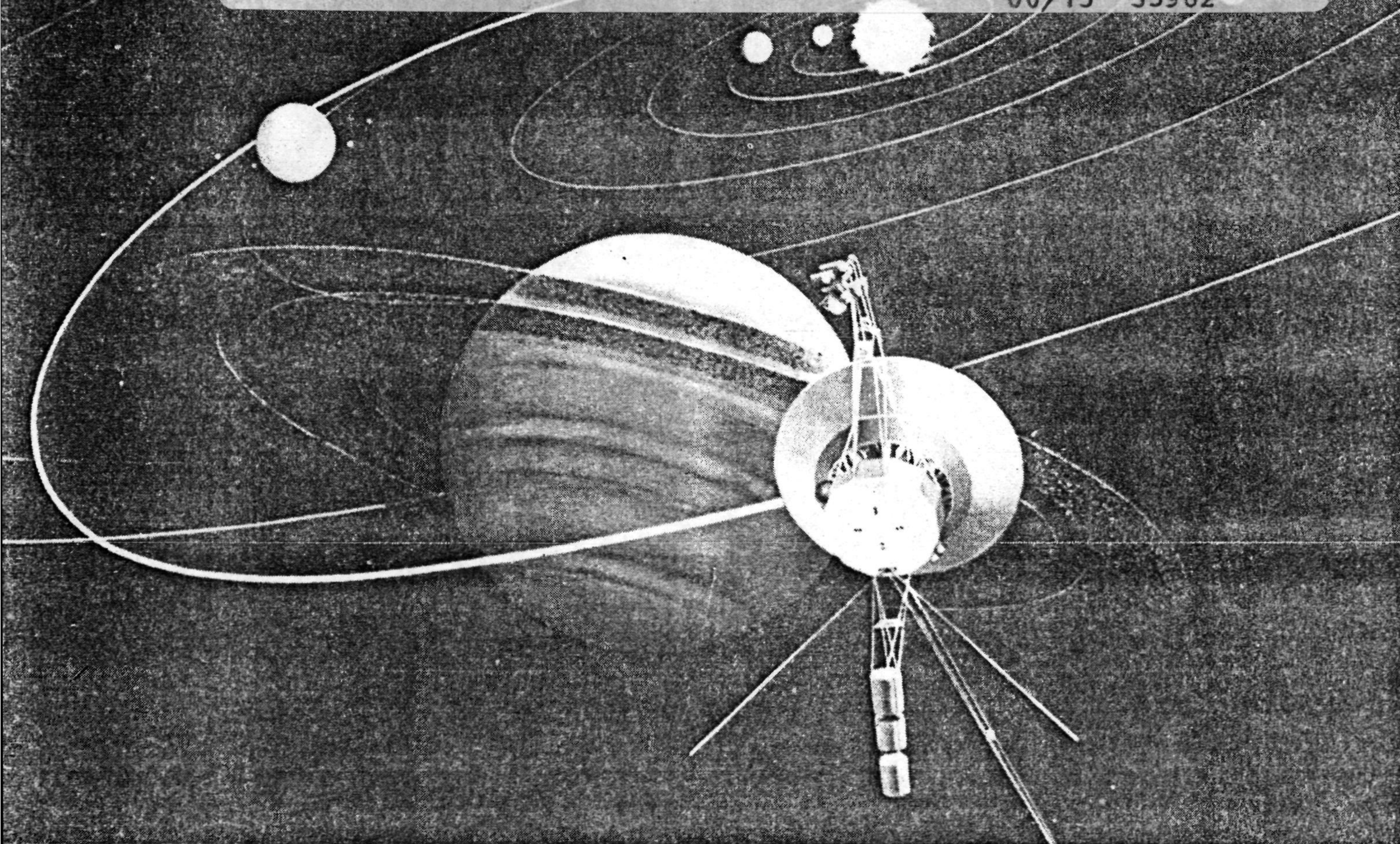
VOYAGER

(NASA-News-Release-77-114) VOYAGER (National Aeronautics and Space Administration) 14 p

N77-79000

Unclas

00/15 35962



National
Aeronautics and
Space
Administration

NOTE TO EDITORS: This fact sheet outlines the mission and basic scientific rationale for Voyager. It is suggested that it be retained in your files for future reference.

For Further Information:

Nicholas Panagakos
Headquarters, Washington, D.C.
(Phone: 202/755-3680)

Frank Bristow
Jet Propulsion Laboratory, Pasadena, Calif.
(Phone: 213/354-5011)

RELEASE NO: 77-114

VOYAGER

The National Aeronautics and Space Administration will launch two Voyager spacecraft in late summer 1977 for an extensive reconnaissance of the outer planets.

Riding atop a Titan Centaur rocket, the Voyagers will be launched from Kennedy Space Center, Fla., on a decade-long odyssey that could take them to as many as 15 major heavenly bodies.

These include giant Jupiter and ringed Saturn and several moons of both planets, probably Uranus and possibly Neptune.

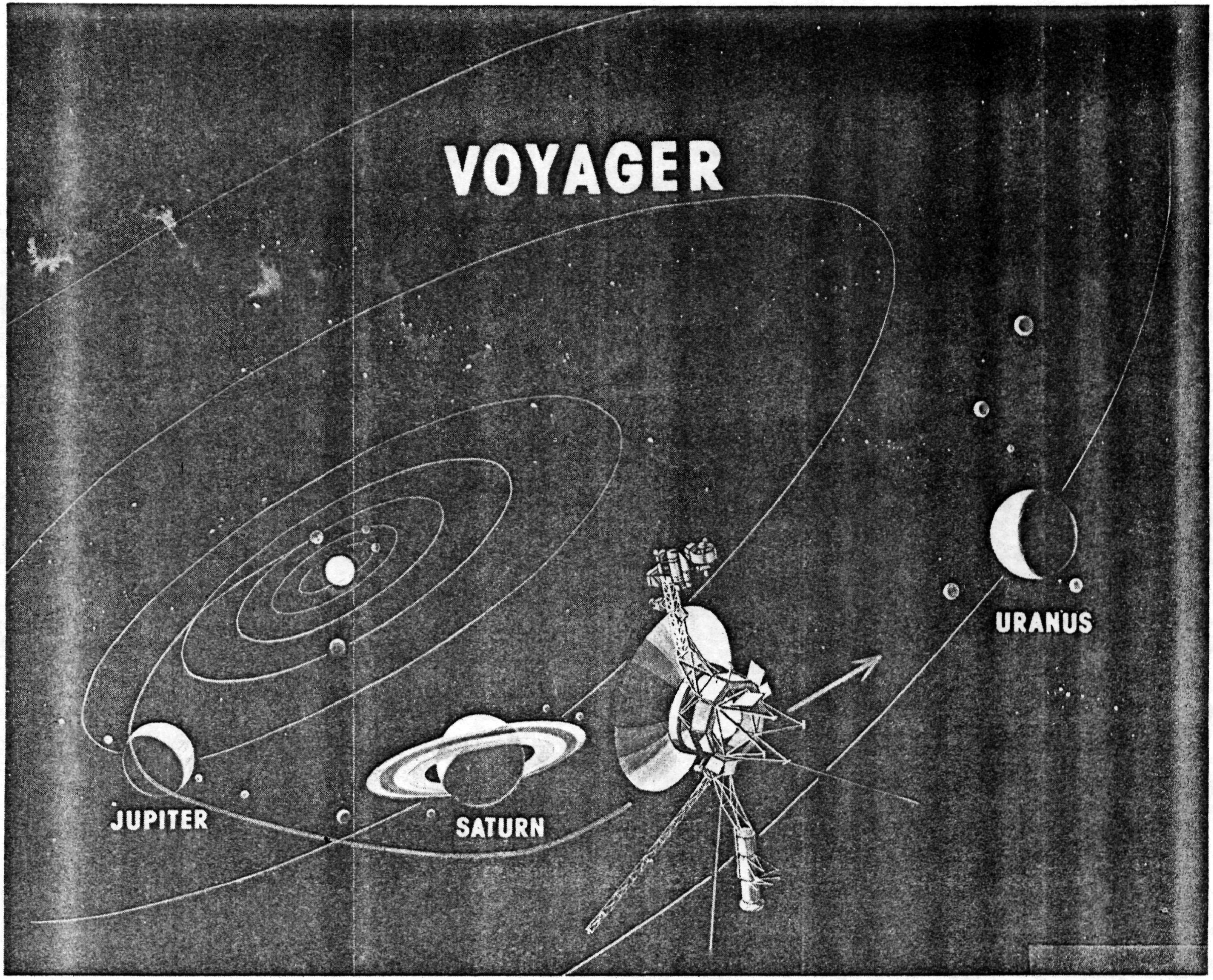
The information returned by the spacecraft is expected to shed new light on the origin and early history of the solar system and our own planet Earth.

Voyager Next Step to Study Outer Planets

NASA has already sent spacecraft to Venus, Mercury, Jupiter and Mars. Project Voyager is the next step in the United States program of systematic planetary exploration in which the solar system is used as a natural laboratory.

The outer region of the solar system is considered the source of much important data about the Sun and its planets. The inner planets -- Mercury, Venus, Earth and Mars -- have gone through considerable evolution in the last four to five billion years. Today we witness at their surfaces and in their atmospheres the end result of long evolutionary processes. In the case of the outer planets and their moons, mainly because of the low temperature that prevailed in the past of the solar system, we can still find objects where evolution has been so slow that today conditions are not so very different from what they were at the time of formation. By exploring the outer planets, we can go back in time and sample the conditions from which the Sun and the planets are believed to have condensed.

-more-


VOYAGER
JUPITER
SATURN
URANUS

Outer Planets Have Many Satellites

Jupiter and Saturn are drastically different from the terrestrial planets, appearing to be composed primarily of hydrogen and helium. Jupiter is larger than all the other planets in the solar system combined. Jupiter has 13 or 14 known satellites (the recently discovered 14th has not yet been confirmed). Jupiter orbits the Sun more than five times farther away than Earth. One Jovian year equals about 12 Earth years. Jupiter's day is about 10 hours long.

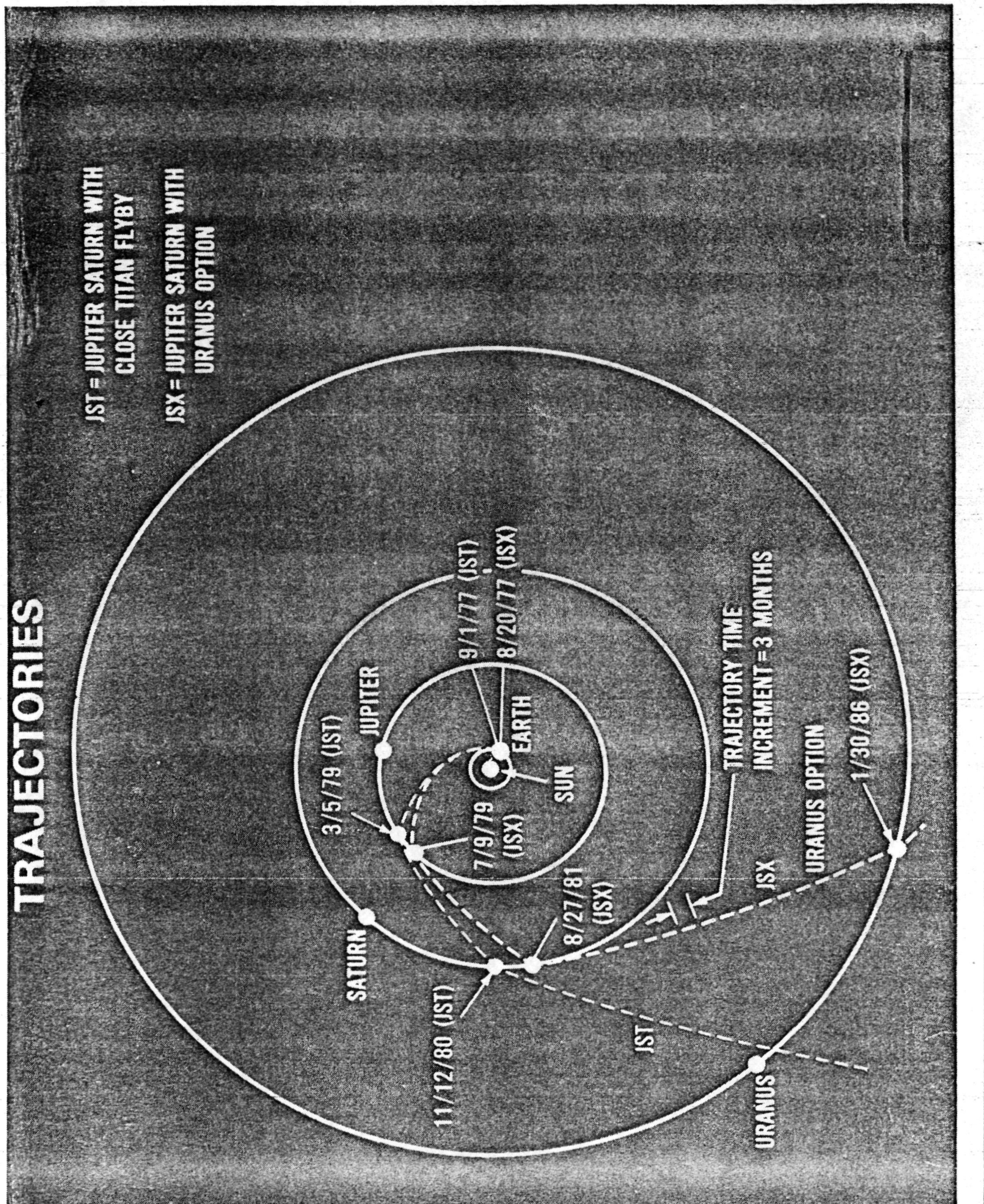
Saturn orbits the Sun almost 10 times as far away as Earth, completing one orbit every 30 Earth years. A day on Saturn is also about 10 hours long. Telescopic observations of Saturn's rings are dazzling. The widest visible ring has an outer radius of 137,000 kilometers (85,000 miles). Saturn has more than 10 satellites, including the largest, Titan, which has an atmospheric density comparable to that of Earth.

Trajectories, Speeds Differ

Plans call for the first launched Voyager to fly a slower trajectory, allowing the second spacecraft -- launched about 12 days later -- to overtake it and reach Jupiter about four months earlier. Jupiter's gravity will slingshot the Voyagers toward the ringed planet Saturn, with the two spacecraft reaching Saturn about nine months apart.

Photography of Jupiter will begin in December 1978, 80 days before the first Voyager reaches the planet. At that time, images of the brightly banded planet will already exceed the resolution of Earth-based photographs. For about two months photography will be continued with the spacecraft's narrow-angle camera, which has a 1,500mm focal-length lens. In late February, eight days from Jupiter, Voyager will begin coverage of the entire planet with its wide-angle camera (200mm focal length), while the narrow-angle instrument provides high-resolution photography of selected features of Jupiter's clouds. At the same time, the infrared and ultraviolet spectrometers and the photopolarimeter will be obtaining data on atmospheric composition, temperature variation in the atmosphere and aerosols in the clouds.

VOYAGER


TRAJECTORIES
JST = JUPITER SATURN WITH CLOSE TITAN FLYBY
JSX = JUPITER SATURN WITH URANUS OPTION
SATURN
JUPITER
EARTH
SUN
URANUS
3/5/79 (JST)
7/9/79 (JSX)
9/1/77 (JST)
8/20/77 (JSX)
11/12/80 (JST)
8/27/81 (JSX)
1/30/86 (JSX)
JST
JSX
URANUS OPTION
TRAJECTORY TIME INCREMENT = 3 MONTHS

Planets' Moons to Get Close Look

Shortly before closest approach to Jupiter -- on March 5, 1979 -- Voyager 1 will fly about 415,000 km (258,000 mi.) from Amalthea, giving scientists their first close look at the innermost of Jupiter's satellites. Closest approach to Jupiter will be 3.9 radii (R_J) from the surface of the planet (about 280,000 km or 110,000 mi.). Jupiter will occult the Sun and Earth, as seen by instruments on the spacecraft, allowing scientists to make precise measurements of the structure and composition of its atmosphere.

After passing Jupiter, the first Voyager will examine all four of the big Galilean satellites: Io from 22,000 km (14,000 mi.), Europa from 733,000 km (455,000 mi.) and Ganymede and Callisto from about 120,000 km (74,000 mi.). Observations of Jupiter will continue for about a month after closest approach, until early April 1979.

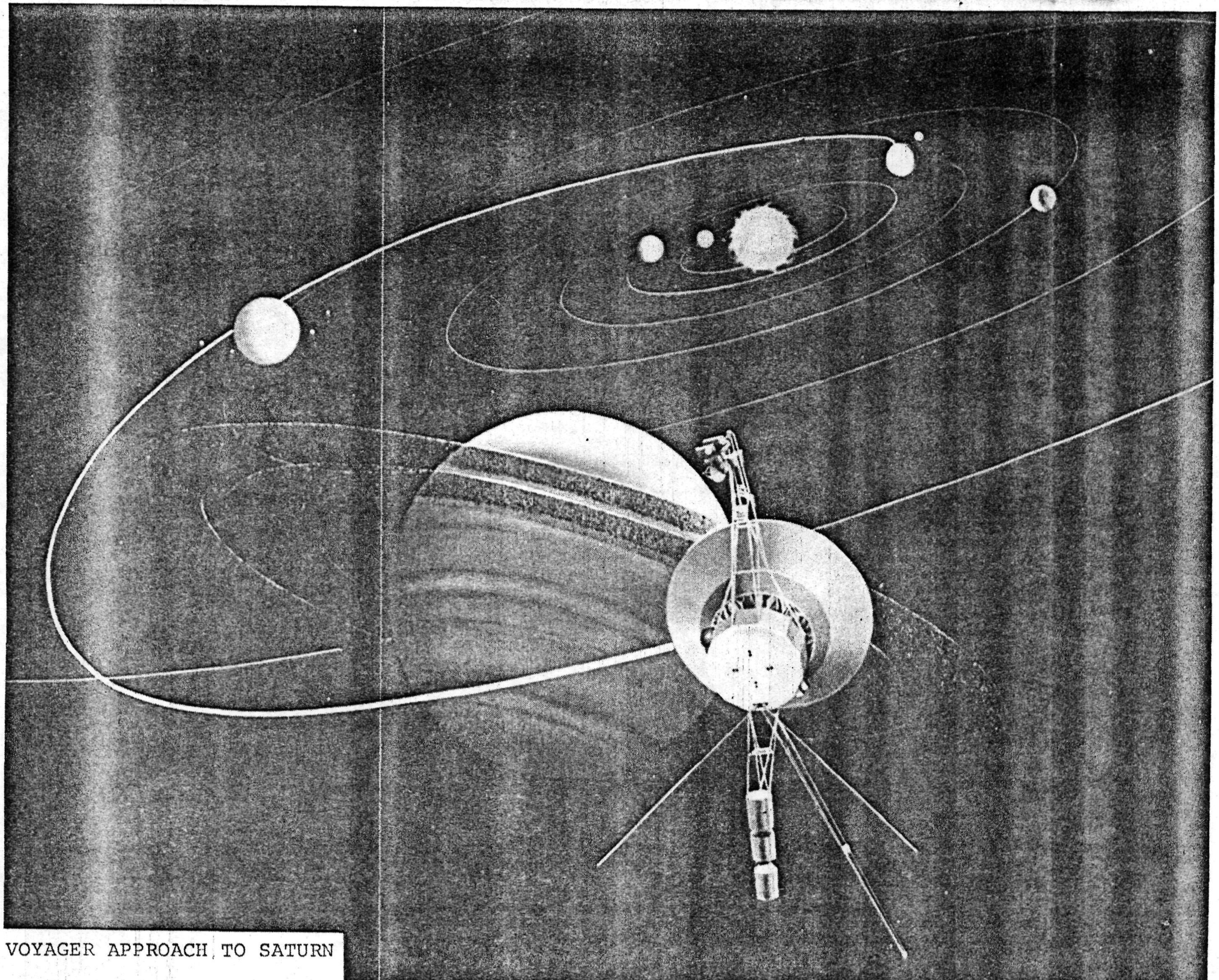
The second Voyager will begin its observatory phase about two weeks later, again 80 days before closest approach. It will observe four satellites during the inbound leg: Callisto from 220,000 km (136,000 mi.), Ganymede from 55,000 km (34,000 mi.), Europa from 201,000 km (125,000 mi.) and Amalthea from 550,000 km (342,000 mi.).

Encounters Scheduled

Closest approach to Jupiter will occur July 10, 1979. The spacecraft, following a more distant path than its predecessor, will pass 643,000 km (399,000 mi.) from the center of the planet. The Jupiter encounter period will continue into August.

The first Saturn encounter will begin in August 1980 and will continue through December. On the inbound leg, Voyager will pass within 4,000 km (2,500 mi.) of the surface of the major satellite Titan. During the encounter it will also scan the satellites Tethys, Mimas, Enccladus, Dione and Rhea as well as observe closely the rings of Saturn. Closest approach to Saturn -- 209,300 km (130,000 mi.) -- will occur Nov. 12, 1980. Titan, Saturn and the rings will occult the Sun and the Earth as seen by instruments on the spacecraft.

Second Saturn encounter will begin in June 1981. Closest approach to Saturn will occur Aug. 27, 1981. The spacecraft will also observe six satellites and Saturn's rings. Encounter will continue through September 1981.



VOYAGER APPROACH TO SATURN

The Voyager spacecraft each weigh 810 kilograms (1,785 pounds). The scientific instruments weigh a total of 105 kg (231 lb.) for each spacecraft. The new Voyager spacecraft differ from past planetary Mariner spacecraft, due primarily to the environment into which they will venture and the great distance across which they must communicate with Earth. Since the outer planets receive only a small fraction of the sunlight that strikes Earth and Mars, the Voyagers cannot depend on solar energy but must use nuclear power -- radioisotope thermoelectric generators. Another obvious difference is the large antenna: the antenna on the Voyager spacecraft is 3.7 meters (12 feet) in diameter.

Onboard Instruments Listed

Each Voyager will use 10 instruments and the spacecraft radio to study the planets, their satellites, the rings of Saturn, the magnetospheres surrounding the planets and interplanetary space.

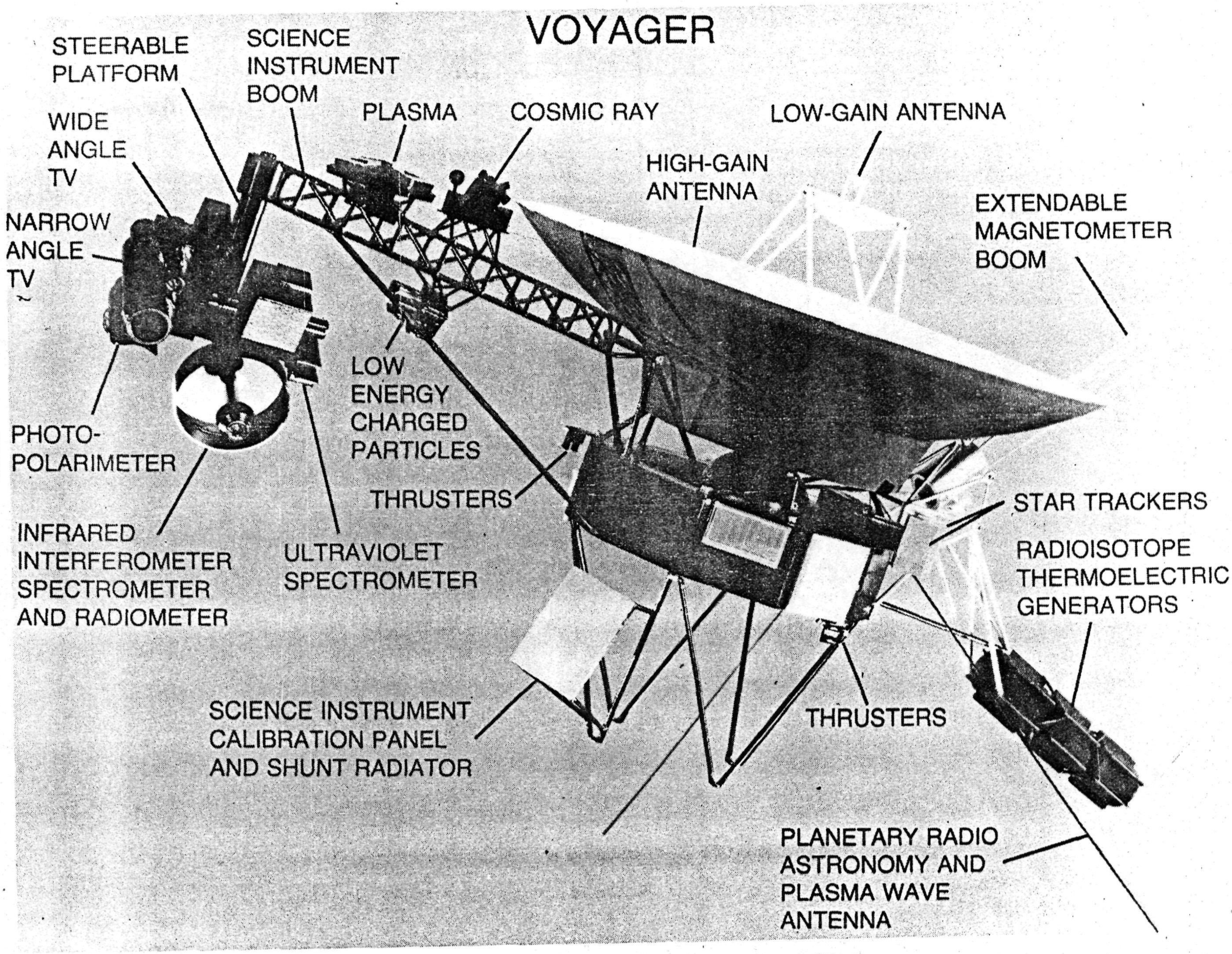
In addition to wide-angle and narrow-angle television cameras, the Voyagers carry cosmic-ray detectors, infrared spectrometers and radiometers, low-energy charged-particle detectors, magnetometers, photopolarimeters, planetary radioastronomy instruments, plasma and plasma wave experiments and ultraviolet spectrometers.

The television cameras are expected to provide scientists with the best pictures of Jupiter and Saturn ever obtained and the first high-resolution close-up images of the Galilean satellites of Jupiter, the major satellites of Saturn and Saturn's rings.

Other instruments will probe the atmospheres of the planets and satellites, their magnetospheres and the interactions between these regions and the solar wind, radio bursts from Jupiter (which emits the strongest radio noise in our sky except the Sun). Other objectives include occultation of Earth and Sun by the planets, Saturn's rings and Titan, all-sky surveys of interplanetary space and location and definition of the heliosphere or boundary of the solar wind.

Trajectories Carefully Chosen

Trajectories were carefully chosen to provide not only good scientific information about the planets, but also about their satellites.


VOYAGER
STEERABLE PLATFORM
SCIENCE INSTRUMENT BOOM
PLASMA
COSMIC RAY
LOW-GAIN ANTENNA
HIGH-GAIN ANTENNA
EXTENDABLE MAGNETOMETER BOOM
WIDE ANGLE TV
NARROW ANGLE TV
PHOTO-POLARIMETER
LOW ENERGY CHARGED PARTICLES
THRUSTERS
STAR TRACKERS
INFRARED INTERFEROMETER SPECTROMETER AND RADIOMETER
ULTRAVIOLET SPECTROMETER
RADIOISOTOPE THERMOELECTRIC GENERATORS
SCIENCE INSTRUMENT CALIBRATION PANEL AND SHUNT RADIATOR
THRUSTERS
PLANETARY RADIO ASTRONOMY AND PLASMA WAVE ANTENNA

-more-

Io, Europa, Ganymede and Callisto -- Jupiter's Galilean satellites -- and Titan qualify as objects for close study in their own right. They range from larger than the planet Mercury down to the size of Earth's Moon; Titan is the only satellite in the solar system known to have an appreciable atmosphere.

The Voyager trajectories make use of the favorable outer planet alignment identified during proposed Grand Tour mission studies to achieve flybys of both Jupiter and Saturn. The most favorable opportunity for a close approach to Jupiter with relatively short flight times to Saturn (less than four years) is the 1977 launch window.

The mission also builds on information gathered about Jupiter by the Pioneer 10 and 11 spacecraft -- particularly about Jupiter's magnetosphere.

Uranus Flyby Optional

NASA officials have an option to send the second Voyager spacecraft on to the planet Uranus, with encounter occurring in January 1986. The Uranus option will be exercised only if primary Saturn science objectives have been met by the first spacecraft and the operating health of the second warrants such an undertaking. There is also a possibility -- because of the alignment of the outer planets -- that the second spacecraft could be targeted to continue on to Neptune after its encounter with Saturn.

Both spacecraft will eventually escape from the solar system after they have completed their encounters with the giant sister planets. They will be tracked by radio from Earth as long as possible to obtain science data on the heliosphere, particularly to study interactions between solar and cosmic radiation.

Tracking Facilities

After launch, tracking and data acquisition will be performed by the Deep Space Network with stations in California, Australia and Spain. At planet encounter, high rate data will be received through the DSN's 64-m (210-ft.) antenna subnet. Maximum data rate at Jupiter is 115,000 bits per second; at Saturn it is 44,000.

The Voyager program is managed by NASA's Office of Space Science, Washington, D.C. Project management responsibility has been assigned to the Jet Propulsion Laboratory, Pasadena, Calif., which is managed for NASA by the California Institute of Technology. JPL designed, developed and built the two spacecraft.

Launch vehicle responsibility has been assigned to NASA's Lewis Research Center, Cleveland, Ohio. Prime contractors to Lewis are Martin Marietta Corp., Denver, Colo. (the Titan), and General Dynamics/Convair, San Diego, Calif. (the Centaur).

Tracking, communications and mission operations are conducted by JPL, which operates the Deep Space Network for NASA's Office of Tracking and Data Acquisition.

The spacecraft's radioisotope thermoelectric generators are provided to NASA by the Energy Research and Development Administration. Prime contractor to ERDA is General Electric. Co., Space Division, Philadelphia, Pa.

Cost of the Voyager project, exclusive of launch vehicles and launch operations and tracking and data acquisition, is estimated at $346 million. Launch vehicles for the mission will cost $71.6 million; and tracking and data acquisition, $32.7 million.

Experiment	Principal Investigator	Instruments and Functions
Imaging Science	Team Leader, Bradford Smith University of Arizona, Tucson	Two TV cameras with 1,500mm, f/8.5 and 200mm, f/2 optics, multiple filters, variable shutter speeds and scan rates. Wide-angle field of view, 56 x 55 millirad (about 3 degrees square). On scan platform.
Infrared Interferometer Spectrometer	Rudolf Hanel Goddard Space Flight Center	Spectrometer-radiometer measuring temperatures and molecular gas compositions, with narrow, 1/4-degree field of view, producing measurements every 48 seconds; on scan platform.
Ultraviolet Spectrometer	A. Lyle Broadfoot Kitt Peak National Observatory	Grating spectrometer measuring ion, atomic, and small-molecular gas abundances; spectral range 400-1600 angstroms; on scan platform.
Photopolarimeter	Charles Lillie University of Colorado	Telescope with variable apertures; filters, polarization analyzers and Proof Test Model (PTM) detector; on scan platform.
Plasma	Herbert Bridge Massachusetts Institute of Technology	Dual plasma detectors, one aligned toward Earth/Sun and one perpendicular, with detection ranges from 4v to 6kv.
Energy Charged Particles	S. M. Krimigis Johns Hopkins Applied Physics Laboratory	Dual rotating solid-state detector sets, covering various ranges from 10 kev to more than 30 Mev/nucleon.

-more-

Experiment	Principal Investigator	Instruments and Functions
Cosmic Ray	F. Vogt California Institute of Technology	High-energy, low-energy and electron telescope systems using arrays of solid-state detectors, several ranges from 0.15 to 500 Mev/nucleon.
Magnetometer	Norman Ness Goddard Space Flight Center	Two low-field triaxial fluxgate magnetometers located roughly 10 m (33 ft.) from spacecraft on boom, two high-field (20 gauss) instruments mounted on spacecraft.
Planetary Radio Astronomy	James Warwick University of Colorado	Two 10-m (33-ft.) whip antennas and two-band receiver (20.4-1300 kHz, 2.3-40.5 MHz), detecting planetary radio emissions and bursts and solar/stellar bursts.
Plasma	Frederick L. Scarf TRW Systems Group	Uses 10-m (33-ft.) planetary radio astronomy antennas with step frequency detector and waveform analyzer to measure plasma waves, thermal plasma density profile at Jupiter and Saturn, satellite/magnetosphere interactions, wave/particle interactions.
Radio Science	Team Leader, Von R. Eshleman Stanford University	Uses spacecraft S-band/X-band links during planet, satellite and Saturn ring occultations to perceive changes in refractivity and absorption; celestial mechanics information calculated from tracking data.

-end-